Ice Age Old Crow

Yukon's ancient history from north of the Arctic Circle

© 2013 Government of Yukon

ISBN 978-1-55362-634-3

Written by Grant Zazula and Duane Froese

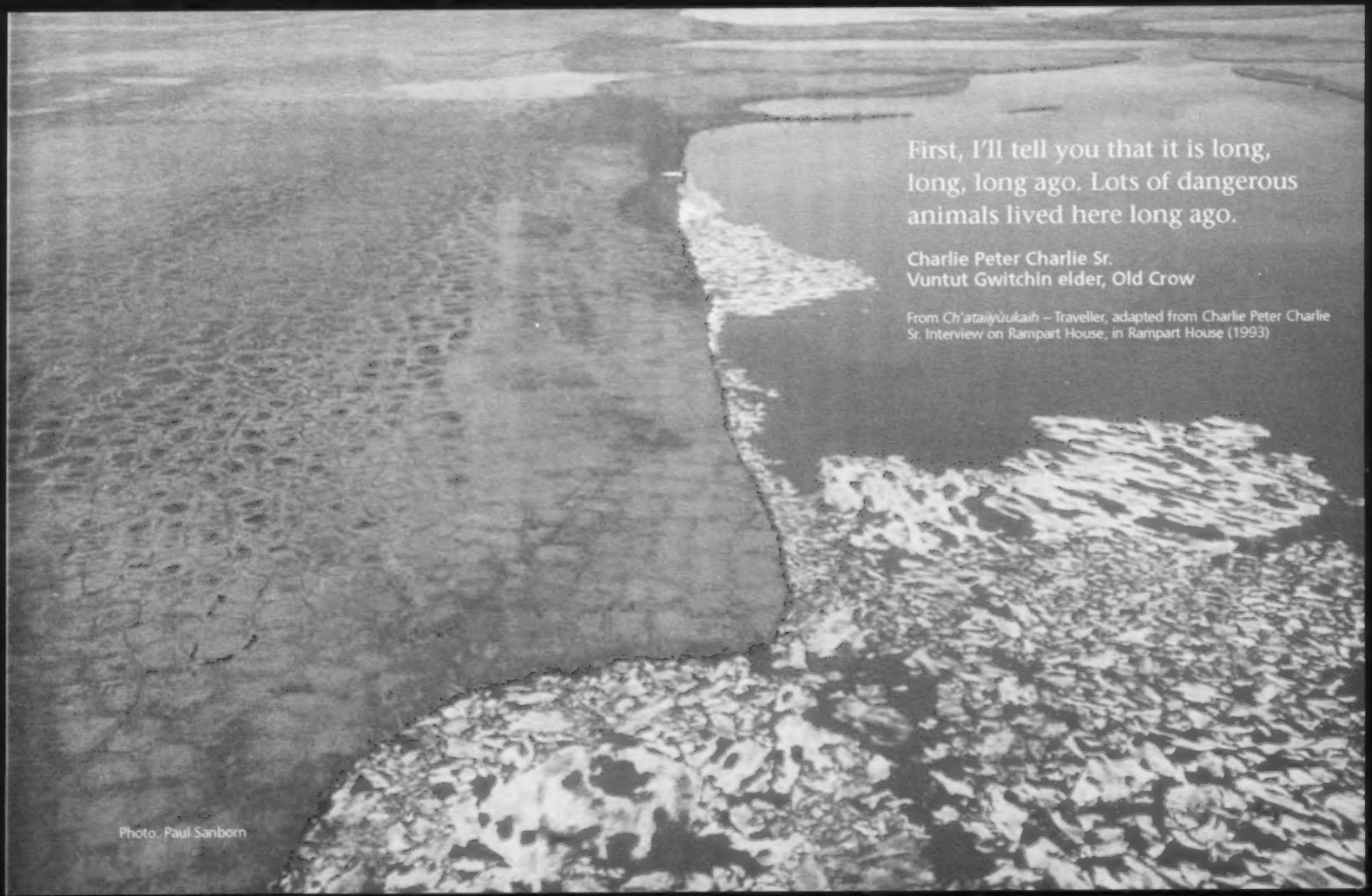
Edited by Patricia Halladay

Design and layout: Patricia Halladay Graphic Design (Whitehorse, Yukon)

All photos courtesy Government of Yukon unless otherwise noted.
CMC: Canadian Museum of Civilization; CMN: Canadian Museum of Nature; VGFN: Vuntut Gwitchin First Nation; VGG: Vuntut Gwitchin Government; YA: Yukon Archives

Front cover: Left: John Kendi with mammoth tusk from sandbar, ca. 1962-65. YA, Pat Swainson fonds, 2006-04 #274;
Right, top: Bones extruding from a bank. IMG2013-0045-0163, CMC; Right, bottom: High above the Porcupine River on *Chijii Vihk'àa* (Big Bluff) in 1991. Photo: Charles Schweger
Back cover: *Chijii Vihk'àa* (Big Bluff), near Old Crow. Photo: Alberto Reyes

This booklet is available online at www.tc.gov.yk.ca. Hard copies are available from the Government of Yukon Palaeontology Program or by e-mailing heritagepublications@gov.yk.ca.


First, I'll tell you that it is long, long, long ago. Lots of dangerous animals lived here long ago.
Charlie Peter Charlie Sr.
Vuntut Gwitchin elder, Old Crow
From *Ch'atailyùukaih* – Traveller, adapted from Charlie Peter Charlie Sr. Interview on Rampart House, in Rampart House (1993)
Photo: Paul Sanborn

Contents

Introduction	3	Bones along the river banks	21
The Old Crow region	4	Ice age mammals	22
Vuntut Gwitchin First Nation	5	Whitestone mammoth	23
Beringia: Crossroads of continents	6	The mammoth family tree	24
In the days when the earth was all covered with water...	7	Giant ground sloth	26
Ice age	8	Arctic camels	27
A vanished world	9	Ice age pigs	28
Early discoveries in the northern Yukon	10	Yukon's big and little horses	29
20th century finds	11	The most ancient bison in North America	30
Otto Geist	12	Beavers the size of bears	31
Operation Porcupine	13	*Ch'ataiiyùukaih*	32
Yukon Refugium Project and Northern Yukon Research Programme	14	Ancient fish	33
Bluffs and riverbanks	15	The mussels of Beringia	34
Ancient pine	16	Bluefish Caves	35
Permafrost history	17	Ice age hunters	36
Glacial Lake Old Crow	18	Ancient caves	37
Old Crow Flats	19	Long-ago stories	38
Old Crow tephra	20	The end of the ice age	39
		Acknowledgements	40

Introduction

The remote village of Old Crow is Yukon's only community north of the Arctic Circle. The fascinating ice age history in this region has captured the imaginations of scientists, the Vuntut Gwitchin and the world for generations.

Bluffs and banks along the Old Crow river are the richest source of ice age fossils in Canada. The Old Crow region also provides important clues about when the first people arrived in North America.

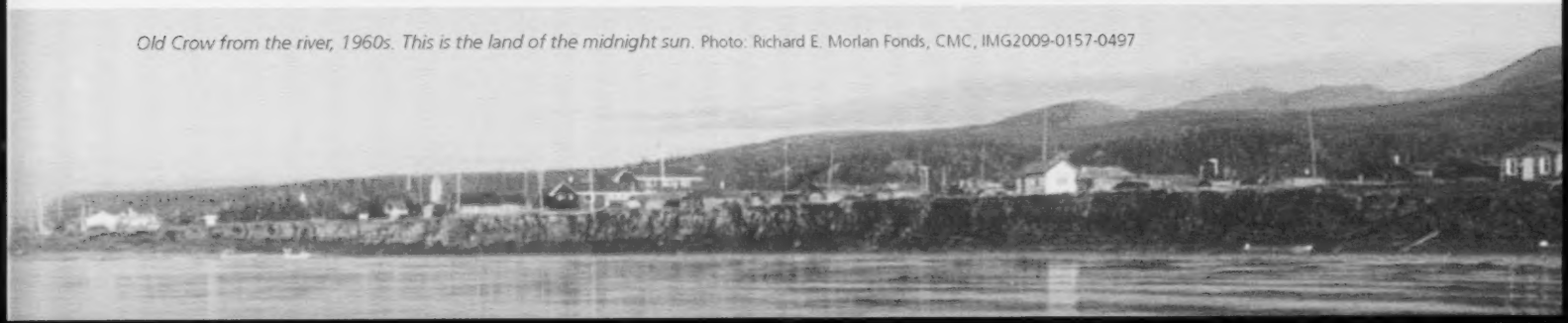
Above: Mammoth skull found near Dawson City 1904, misidentified as mastodon.
Photo: Dawson City Museum 1990.54.35

In addition, layers of sediment and soil laid down over millions of years provide a crucial framework for the study of climate change in the Arctic.

Scientific evidence from the Old Crow region provides many answers — and even more questions — about the long-vanished ice age world.

Palaeontologists study prehistoric fossils to discover how ancient life evolved and coexisted. Some palaeontologists study the fossil record of humans and their ancestors, but it is **archaeologists** who work with human remains and human-made objects.

Photo: Richard E. Morlan Fonds, CMC, IMG2013-0053-0001, # MMV-24-1



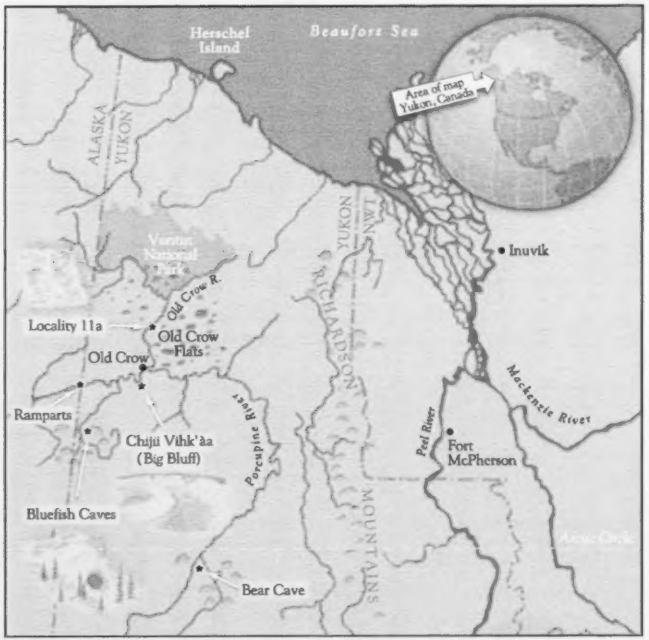
Old Crow from the river, 1960s. This is the land of the midnight sun. Photo: Richard E. Morlan Fonds, CMC, IMG2009-0157-0497

The Old Crow region

A July snowfall blankets a study site near Old Crow, circa 1970.
Photo: Richard Harington

Because of its remote location, the Old Crow region has always been difficult to get to. Before the days of airplanes, the trek to Old Crow required a steamship journey up the Pacific Coast to Skagway, Alaska, a narrow-gauge railway to Whitehorse, a Yukon River sternwheeler for the downstream run to Dawson, changing to a lower river sternwheeler for the journey to the mouth of the Porcupine River *(see photo, page 11)*. Even today, Old Crow is not connected to Yukon's road system; airplanes provide the main access.

For scientists from across the country or even farther away, this remoteness means that most supplies for field research have to be shipped in advance or brought with them.



Map: Tanya Handley

Left: John Matthews with supplies, circa 1977. Crates and pails full of dry food, camping gear and research equipment are essential for the weeks or even months spent in the field. Outfitting the large field parties of the Yukon Refugium Project and the Northern Yukon Research Programme (see page 14) took careful planning to keep the research going.
Photo: Richard E. Morlan Fonds, CMC, IMG2013-0047-0262

Vuntut Gwitchin First Nation

An integral part of the story of ice age research in the Old Crow region is the continued involvement of the Vuntut Gwitchin. Since ancient times they have encountered the fossils of strange ancient beasts as they traversed the land and travelled the river.

The importance of these ancient fossils is reflected in stories told by elders about how life as they know it came to be. Since the first arrival of scientists more than a century ago, the local people of Old Crow have provided valuable assistance and taken the time to share their stories and culture.

With the signing of land claims and self-government agreements in 1993 the Vuntut Gwitchin gained greater responsibility for the management of ancient artifacts and fossils on their land. As a result, the Vuntut Gwitchin Government (VGG) owns and manages all fossils and artifacts found since 1995 on Vuntut Gwitchin Settlement Land. The creation of Vuntut National Park in 1995 further highlighted the importance of ice age research in the Old Crow region to the people of Canada.

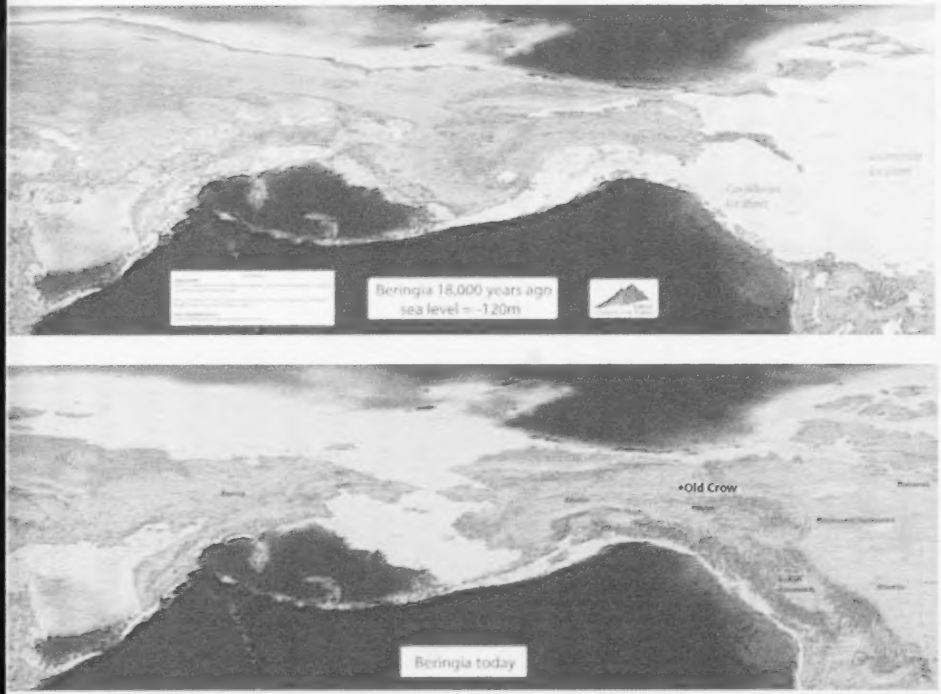
Above: Charles Linklater on the barge, ca. 1970.
Photo: Clara Linklater collection

Richard Harington excavates a mammoth tooth along the Old Crow River with field assistant Charlie Thomas, circa 1980. Photo: G R. Fitzgerald

The Vuntut Gwitchin have lived in the region since ancient times. They have close ties with other Gwich'in across Alaska, Yukon and the Northwest Territories.

Stephen Frost Sr. and Robert Bruce Jr. at the Firth River fish hole during the Van Tat Gwich'in Navigation Systems Project.
Photo: VGG

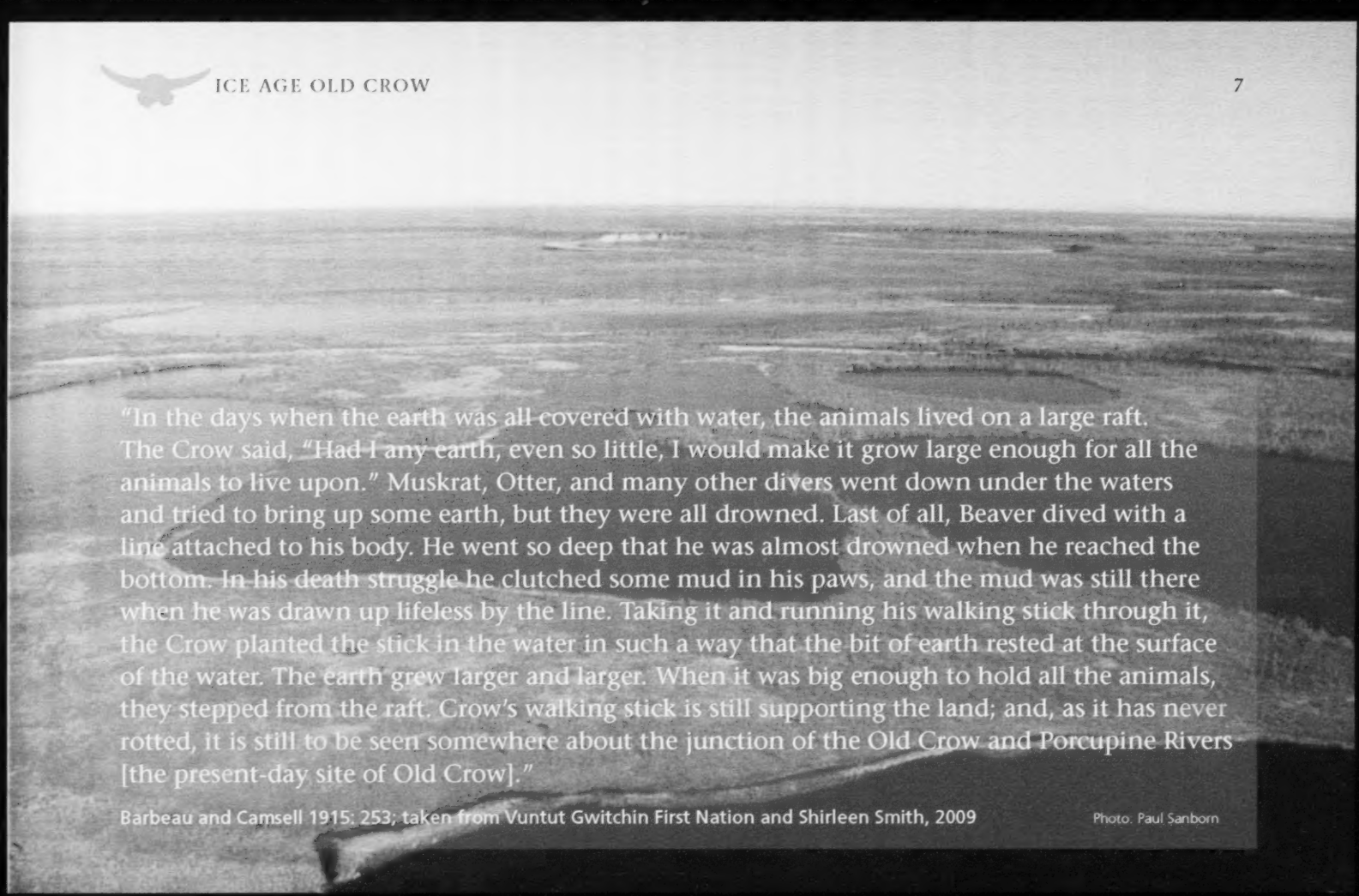
Beringia: Crossroads of continents



Maps: Jeff Bond, Yukon Geological Survey

The Old Crow region of northern Yukon is located at the eastern edge of Beringia. This ice age land mass included a land bridge across the Bering Strait that connected Asia and North America (left, above). Sea levels decreased and the land bridge formed when much of the world's water became locked in glacier ice. Many plants and animals — including humans — made their way to Yukon across the land bridge.

Animals that evolved in the southern part of North America also made their way to Yukon at different times during the ice age. Some of these mammals followed the return of forests to Yukon during warm intervals similar to today (left, below). The Old Crow region contains fossils — from animals such as sloths and camels — that provide evidence of these migrations to the western Arctic. This history of animals' migrations from Asia and the south are revealed in the rich fossil record found around Old Crow.



"In the days when the earth was all covered with water, the animals lived on a large raft. The Crow said, "Had I any earth, even so little, I would make it grow large enough for all the animals to live upon." Muskrat, Otter, and many other divers went down under the waters and tried to bring up some earth, but they were all drowned. Last of all, Beaver dived with a line attached to his body. He went so deep that he was almost drowned when he reached the bottom. In his death struggle he clutched some mud in his paws, and the mud was still there when he was drawn up lifeless by the line. Taking it and running his walking stick through it, the Crow planted the stick in the water in such a way that the bit of earth rested at the surface of the water. The earth grew larger and larger. When it was big enough to hold all the animals, they stepped from the raft. Crow's walking stick is still supporting the land; and, as it has never rotted, it is still to be seen somewhere about the junction of the Old Crow and Porcupine Rivers [the present-day site of Old Crow]."

Barbeau and Camsell 1915: 253; taken from Vuntut Gwitchin First Nation and Shirleen Smith, 2009

Photo: Paul Sanborn

Ice age

The ice age is the time span from 2.6 million to 10,000 years ago. This period is called the Pleistocene Epoch. For most of that time, the climate was colder than it is now and colossal glaciers covered nearly all of Canada.

These cold periods are called *glacials*. The ice age also included brief warm intervals when glaciers melted and forests returned to the north. The warm times during the ice age are called *interglacials*.

The Old Crow area is unique and important to scientists. Even when the climate in this Arctic region was extremely cold during the ice age, the region was never covered by glaciers. This is because it was too dry for the area to develop large sheets of ice.

Since it was always free of glaciers, the land provided a refuge for animals in the north. When these beasts died, their bones were left behind as fossils. One of the reasons that the fossils of ice age mammals are so plentiful in the Old Crow area is that the land wasn't scoured by glaciers.

Colossal advancing glaciers from the central Arctic did have dramatic impacts on the landscape surrounding Old Crow. Evidence of this is found in the soil and sediment exposed along rivers, caves and mountains.

Above: Cross-section from a fossil white spruce stump dating to the last interglacial. Tree fossils provide important information about climates of the ancient past. Photo: Alberto Reyes

Above: The advance and retreat of glaciers has shaped the Canadian landscape.

Left: The cranium of a Steppe bison at Old Crow Locality 11, an incredibly rich fossil site.

Photo: Richard Harington

A vanished world

It's fascinating to think about how different the ice age landscape may have looked in comparison to the world that today's people of Old Crow know so well. This comparison is even more extraordinary when we consider that the ice age occurred only yesterday in geological time.

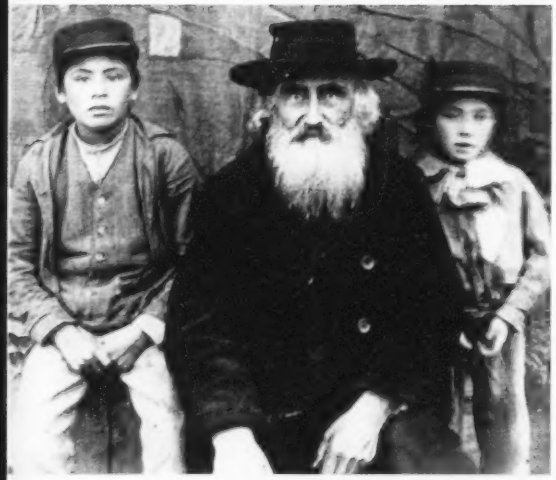
During much of the ice age, small brightly coloured tundra flowers blew in the cold wind in a dry grassland. They were later replaced by the stunted spruce forests and boggy tundra ponds that are so prominent today. Ice age hunters were more likely to see a horse along the shores of a giant glacial lake than a moose trudging through the forest.

Decades of research in the Old Crow area have revealed a vivid picture of this ice age world. This vanished realm has not been forgotten because of the efforts of many people who have helped collect, study and preserve the area's fascinating ice age history. It is also revealed in the stories of the Vuntut Gwitchin.

Top right: Elizabeth Hall and Stephen Charlie screening mud for rodent fossils.
Photo: Svetlana Kuzmina

Illustration: George (Rinaldino) Teichmann

Early discoveries in the northern Yukon



Above: Archdeacon Robert McDonald with sons Neil and Hugh. McDonald's wife was a Gwich'in woman, Julia Kutug.
YA, ACC General Synod Collection, 78/67 #90

The ancestors of the Vuntut Gwitchin were intrigued by the unusual bones they encountered while hunting, trapping and fishing along the rivers. The first written record of fossils in the region was from Anglican missionary Reverend Robert McDonald.

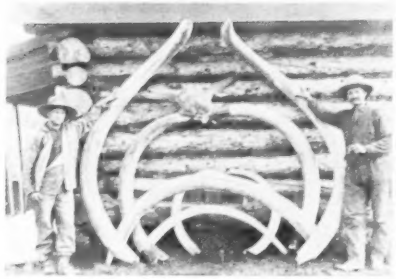
In 1872 McDonald established a church mission on the Porcupine River near the present-day village of Old Crow. He collected the bones of ancient muskox and some fossil mammoth molars. These are part of the permanent collection of the British Museum in London, United Kingdom.

The late 19th century was an exciting time for science. Charles Darwin's *On the Origin of Species...* was published in 1859, and debates about evolution and fossils were raging. Early discoveries of the fossils of ancient members of the elephant family *(see page 24–25)* and other extinct animals above the Arctic Circle made a strong impression on the scientific community.

Most people knew about life in the past only from religious teachings. The study of fossils and palaeontology was in its infancy. The gradual recognition that animals evolved over time shaped how we now understand the ice age.

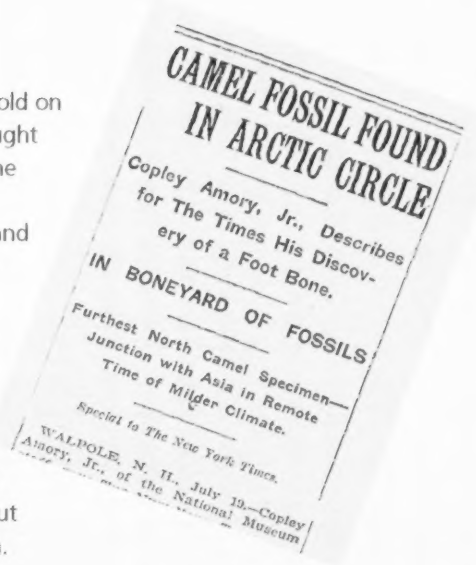
Left: Illustration from Darwin's seminal work, On the Origin of Species.
Smithsonian Libraries

20th century finds



Gold miners with mammoth tusks unearthed in the Klondike, circa 1900.
YA, J.B. Tyrrell fonds, 82/15 #419

The tumult that followed the discovery of gold on Bonanza Creek in the summer of 1896 brought global attention to Yukon. Gold miners in the Klondike unearthed the bones of ancient animals as they worked the frozen ground and scientists from around the world flocked to Yukon and Alaska. Permafrost — or permanently frozen ground — can form when the average annual air temperature is lower than the freezing point of water. It is found throughout Yukon.



CAMEL FOSSIL FOUND IN ARCTIC CIRCLE

Copley Amory, Jr., Describes for The Times His Discovery of a Foot Bone.

IN BONEYARD OF FOSSILS

Furthest North Camel Specimen—Junction with Asia in Remote Time of Milder Climate.

Special to The New York Times.

WALPOLE, N. H., July 19.—Copley Amory, Jr., of the National Museum

In June 1904 the Smithsonian Institution in Washington, D.C. sent an expedition led by A.G. Maddren to the Old Crow River. Maddren took direction from the local Vuntut Gwitchin and collected fossils that are now part of the collections of the Smithsonian.

Right: *New York Times*, July 20, 1913 *(for more on camels, see page 27)*

"It was with much reluctance we [turned back], for nearly every mile of the last hundred travelled on the Old Crow River had yielded increasing evidence... of large Pleistocene mammals." A.G. Maddren, 1905

The Alaskan Yukon field parties of 1910, including A.G. Maddren, at Dawson City on the sternwheeler Susie, *June 15, 1910.* Photo: USGS Photographic Library

Otto Geist

Fossil collecting in the Old Crow area got serious in the 1950s with the work of Otto Geist of the University of Alaska, sponsored by New York's Explorers Club. This expedition proved successful, and owed much to the guidance of Charlie Linklater and Peter Lord of Old Crow. Many of Geist's collections are housed at the American Museum of Natural History in New York.

l–r: Peter Lord, John Nukon, Otto Geist and Alfred Charlie, August 27, 1953. Explorer's Club, New York

In August 2008, Lance Nagwan, with geologists Bernard Lauriol and Ian Clark, discovered artifacts such as this lantern left behind by Otto Geist's exploration of Bear Cave in the 1950s.
Photo: Bernard Lauriol

"We could see the fossils on the river bottom as we travelled along. We collected only the valuable ones, mostly mammoth teeth." Otto Geist, 1956

l–r: Richard Harington and USGS Pleistocene geologist Tom Hamilton excavate the test pit at the site where the flesher (below) was found, circa 1968.
Photo: William N. Irving Fonds, CMC
IMG2013-0032-0008

Operation Porcupine

In 1962 the Canadian government took a major interest in assessing the hydro-electric potential of the Old Crow region. Led by geologist Owen Hughes of the Geological Survey of Canada, "Operation Porcupine" mapped the region's geology and led the way for much of the future ice age research in the area.

Hughes passed on word of the area's fossil bones to palaeontologist Richard Harington, with the National Museums of Canada. Harington made his first major collection of ice age fossils from the Old Crow River in 1966. His work inspired scientists and the Vuntut Gwitchin for years to come.

Old Crow River Locality 11a was a focus of detailed excavations and a hub of activity in 1976. Photo: Richard E. Morlan Fonds, CMC
IMG2013-0047-0203

Harington showed some of the broken bones to archaeologist William Irving, which launched the search for evidence of ice age people in northern Yukon. Harington and Irving's work along the Old Crow River yielded tens of thousands of fossils; they are a treasured part of the national collection at the Canadian Museum of Nature in Ottawa.

This caribou bone has been turned into a flesher, used to skin hides. In the early 1970s it was dated as being 27,000 years old. This drew attention from archaeologists across the globe. However, it was re-dated in the early 1990s with more advanced methods and turned out to be only 2,000 years old.
Photo: William N. Irving Fonds, CMC, # MIVI-1.1.CA

Yukon Refugium Project and Northern Yukon Research Programme

In the mid-1970s, with the interest in ancient bones and ice age geology, two major scientific research programs were launched in Old Crow. The Yukon Refugium Project — led by Richard Morlan and Richard Harington of the National Museums of Canada; Owen Hughes and John Matthews Jr. of the Geological Survey of Canada; and Nat Rutter and Charles Schweger of the University of Alberta — focused on the study of ice age ecosystems across the northern Yukon.

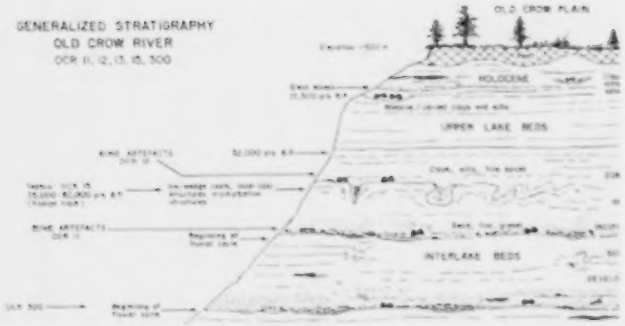
The Northern Yukon Research Programme (NYRP), led by William Irving and Jacques Cinq-Mars of the University of Toronto, was driven largely by the goal of discovering evidence of ancient people in the Old Crow region.

Both of these groups brought diverse teams of scientists and many students to the Old Crow region. Many scientists who worked on these research programs are still remembered fondly by the people of Old Crow and their research has left an incredible legacy for anyone interested in ice age Old Crow.

Above: Research groups have been using Richard Harington's cabin on the bank of the Porcupine River for over four decades. Palaeontologist Elizabeth Hall sorts through sacks of fossils, samples and gear at the end of a long field work season in 2007. Photo: Grant Zazula

Top: William Irving and Mary Charlie, Old Crow, 1967.
Photo: Richard E. Morlan Fonds, CMC IMG2009-0157-0492

Above: Richard Morlan and John Matthews Jr. taking a break on the Eagle River, southeast of Old Crow, 1975.
Photo: Charles Schweger



Above: Diagram of the layers of sediment exposed in the bluffs along the Old Crow River (detail). William N. Irving Fonds, CMC, IMG2013-0032-0010

Bluffs and riverbanks

The Old Crow Flats and other low-lying areas in the region are part of an enormous basin. Its sediments contain a geological record of environmental change that spans several million years. Since the end of the ice age rivers have cut through these sedimentary layers, forming huge bluffs — often 40 or 50 metres high — along the riverbanks.

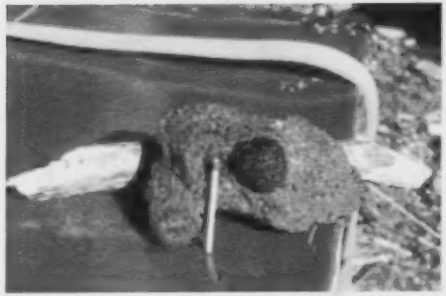
Geologists examine the layers of sand and silt in the bluffs to learn how climate and the landscape have changed. Ancient bones are constantly eroding from the bluffs and washing downstream to bars and riverbanks. One riverbank, known as Locality 11A, has been described as a "supermarket" of bones because of the abundance and diversity of fossils there.

Old Crow River Locality 11A is considered the most rich and diverse fossil locality in the region. This point bar on the river's edge has yielded thousands of ice age fossils as well as archaeological artifacts.

Right: Geologist Tom Ager from the United States Geological Survey examining sediments high above the Porcupine River on Chijii Vihk'àa *(Big Bluff) in 1991.* Photo: Charles Schweger

Ancient pine

Fossil cones, needles, stumps and wood from an extinct species of pine tree have been found at the base of the large cliff known as *Chijii Vihk'àa* (Big Bluff) on the Porcupine River. The fossil pine was named *Pinus matthewsii* in honour of John Matthews Jr. of the Yukon Refugium Project. He studied the fossils of ancient plants and beetles in the Old Crow region.



Analysis by palaeobotanists Charles Schweger and Ruth Stockey revealed that this long-extinct pine tree inhabited the Old Crow region between 5 and 2.6 million years ago. The pine trees lived alongside spruce, larch and birch trees in dense forests above the Arctic Circle.

Pinus matthewsii is related to present-day lodgepole pine. Today, lodgepole pine trees are restricted mostly to the southern Yukon, where they arrived only recently.

Above, left: Ancient pine cone fossil collected from Pliocene sediments at Chijii Vihk'àa *(Big Bluff) in 1978.* Photo: John Matthews Jr.

Above, right: Fossil stump of an extinct pine tree at the base of Chijii Vihk'àa *(Big Bluff), 2004.*
Photo: Duane Froese

Below: Charles Schweger. His research indicates an absence of pine during ice age interglacials.
Photo: John Matthews Jr.

The period between 5 and 2.6 million years ago is called the **Pliocene.** It was a relatively warm period before the last ice age.

Permafrost history

Some of the earliest evidence of permafrost in North America is found along the Porcupine River at *Chijii Vihk'àa* (Big Bluff). Frost cracks close to river level are associated with remnants of pine trees that grew before the ice age.

These forests grew in an area where permafrost probably formed and disappeared many times over thousands of years during the Pliocene, from 5 to 2.6 million years ago. Since then, permafrost has occurred only intermittently.

Most permafrost in the Old Crow area is quite young, unlike that in the Dawson City region. The development of lakes at various times during the ice age thawed permafrost at the lake bottoms. The ground would then refreeze only after the lake drained. Much of the region was covered by a large glacial lake as recently as 15,000 years ago *(see page 18)*, which means that most of the permafrost along valley bottoms and Old Crow Flats is younger than that.

Above: Ice wedges develop over many years when the ground cracks during very cold winters and is filled in by snow melt.

Right: Frost cracks in ice age sediments provide evidence of ancient permafrost.

Both photos: Duane Froese

Today, ice-rich permafrost is visible along many of the river valleys where erosion has exposed it to warm summer air. As in many areas of the Arctic, ground temperatures in the Old Crow area are warming. The Vuntut Gwitchin have documented dramatic changes in their traditional lands in recent times.

Above right: A thaw slump on the Old Crow River. Ice-rich permafrost can thaw rapidly if disturbed by river erosion. Photo: Duane Froese

Glacial Lake Old Crow

Although glaciers never covered the Old Crow region, they still had a dramatic effect on the local landscape. When colossal glaciers butted up against the eastern side of the Richardson Mountains, these walls of ice blocked the course of the rivers that flowed out to what is now the Mackenzie River area.

Water from the Peel River, combined with melt-water from the glaciers, backed up and formed huge lakes in Yukon. The largest was Glacial Lake Old Crow. This massive lake covered an area roughly 13,000 sq. km over the Old Crow Flats and stretched up connecting river valleys.

Map: Tanya Handley

Palaeontologist Jessica Metcalfe cuts small pieces off Woolly mammoth bones to be later analyzed for radiocarbon dates.

Radiocarbon dating indicates that the lake was short-lived in geological terms, existing only between about 20,000 and 15,000 years ago. It was probably covered with ice for most of the time because of the extremely cold and dry climate. The lake level eventually rose and spilled over the basin edge near the present Yukon-Alaska border. This formed the deep canyon known as the Ramparts and caused the Porcupine River to flow west into Yukon River system *(see page 34)*.

Distinct thick beds of frozen grey clay that were deposited at the bottom of Glacial Lake Old Crow are now exposed along river bluffs in the region. The former extent of the lake is marked by thousands of small ponds and lakes.

Radiocarbon dating measures the amount of radioactive carbon 14 in fossil bones and plants, which decays at a rate that can be measured precisely.

Old Crow Flats

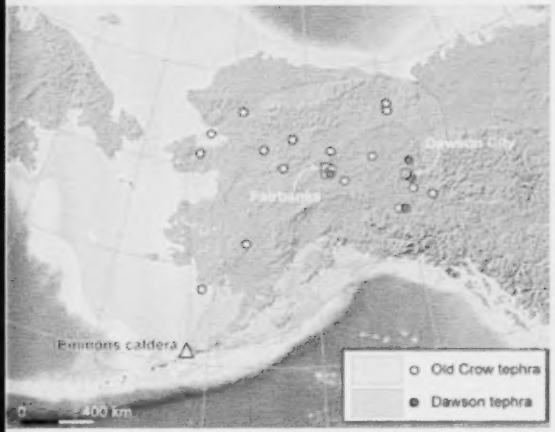
This vast plain contains thousands of small tundra lakes and ponds. It is one of the most ecologically important wetlands in the Arctic, providing breeding habitat for an abundance of aquatic mammals as well as waterfowl and other birds.

The Old Crow Flats are integral to the fishing, hunting and trapping culture of the Vuntut Gwitchin and to understanding the history of this region.

The lakes formed on the surface where Glacial Lake Old Crow used to be after it drained about 15,000 years ago *(see facing page)*. When Glacial Lake Old Crow drained, the climate of the Old Crow region was still locked in ice age conditions. The cold Arctic temperatures led to the development of permafrost in the lake sediments.

As temperatures rose at the end of the ice age and forests started to develop, this permafrost melted, causing lakes to form. Some of these lakes drained shortly afterward and peat and vegetation developed in their lake basins.

Photo: Kevin Turner



Old Crow tephra

Volcanoes from Alaska left behind important clues to the record of ice age Old Crow. Clouds of tephra or ash from volcanoes as far away as the Aleutian Islands blanketed Yukon numerous times during the ice age.

Above: The vast distribution of Old Crow tephra (125,000 years old) and Dawson tephra (30,000 years old). Map: Alberto Reyes and Duane Froese

Old Crow tephra is found at numerous sites across Alaska and Yukon. Analysis of the ash by geologist John Westgate and his lab at the University of Toronto reveal that it fell on the Old Crow region around 125,000 years ago. It is from the largest volcanic eruption in Eastern Beringia *(see page 6)*, which deposited roughly 200 cubic km of ash across Alaska and Yukon.

This thin bed of volcanic ash is often found below logs and other remains of ancient forests. Old Crow tephra is an important marker of the last interglacial, when global climates warmed significantly and forests were re-established across Yukon. Lakes in the area expanded and much of the permafrost likely melted under these lakes and along the river valleys.

Below: Augustine volcano, Alaska, erupting in 1986. Photo: United States Geological Survey

Below: Geologist Britta Jensen points to Old Crow tephra on the Porcupine River in 2004. The significance of Old Crow tephra was first noted by geologist John Westgate during his days with the Northern Yukon Refugium Project.
Photo: John Westgate

Bones along the river banks

This is the richest ice age fossil region in Canada. Every spring, thousands of fossil bones and teeth erode from the bluffs and are deposited on the river banks. They also appear on the bottom of the shallow sections of the river.

This erosion mixes up bones of different ages and sizes. It is common for bones from extinct animals that died one million years ago to be found alongside others that are only a few thousand years old. Minerals naturally found in the water stain most of them a dark reddish brown.

Fossil bones have been fractured in ways that some archaeologists attribute to early ice age peoples. Richard Morlan and Robson Bonnichsen of Yukon Refugium Project and William Irving of the Northern Yukon Research Program championed the idea that hunters migrated to the Old Crow region from what is now Siberia early in the ice age, and that they broke bones from recently killed animals while butchering Woolly mammoth, bison and other ancient mammals. However, this theory remains controversial to many scientists.

Left: Duane Froese with a pile of bones at Petunia Point.
Photo: Grant Zazula

John Storer discovers a fossil bone as soon as he steps out of a helicopter along the Old Crow River in July 2004. John was the first Government of Yukon Palaeontologist, in 1996. Photo: Duane Froese

In the early 1980s Richard Morlan tried to replicate the Old Crow fossil artifacts with tools made of elephant bone. The modern replica is on the left; the fossil artifact is on the right.
Photo: Richard E. Morlan Fonds, CMC (MG2013-0048-0090)

Ice age mammals

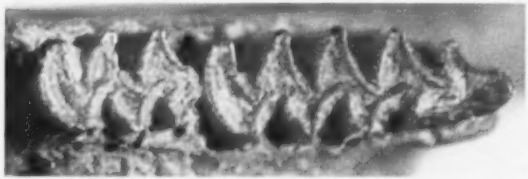
Ancient mammal fossils are the hallmarks of Old Crow's ice age history. More than 60 ice age mammal species have been found in the Old Crow area, including many not found anywhere else in Canada. Collections of these fossils reside mainly at the Canadian Museum of Nature in Ottawa and the Arctic Research Facility in Old Crow.

The fossils are dominated by the iconic beasts of the ice age: Woolly mammoth *(Mammuthus primigenius)*, Steppe bison *(Bison priscus)*, horse *(Equus)* and lion *(Panthera)*. These mammals dominated the rich grassy tundra that covered Yukon landscape during the coldest and driest stages of the ice age. This extinct ice age ecosystem — called "mammoth steppe" — spanned the globe from Yukon to western Europe.

Other animals, such as mastodon *(Mammut americanum)*, Giant ground sloth *(Megalonyx jeffersonii)* and Western camel *(Camelops hesternus)*, likely ventured north to Yukon only during the warmer, wetter times of the last interglacial, 125,000 years ago. These forest-dwelling giants originated in the south.

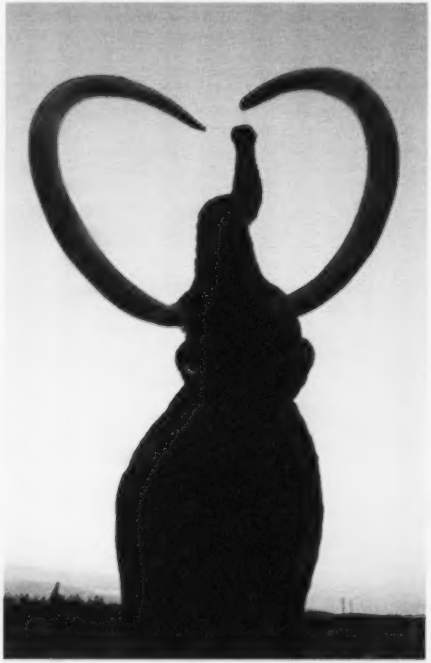
It is likely that interglacial animals didn't last long in Yukon, and were locally wiped out around 75,000 years ago when climates returned to cold glacial conditions. These animals never made their way to Asia — they lived during a time when the Bering Land Bridge was flooded *(see page 6)*.

The Old Crow region was also home to some strange and rare ice age species, such as hyena *(Adcrocuta)*, Short-faced skunk *(Brachyprotoma obtusata)*, and Giant pika *(Ochotona whartoni)*.



Far left: mammoth bone and bison skull, August 1978.
Photo: Ruth Gotthardt

Above: Not all ice age ceatures were giants. Fossil rodent jaws and molars such as this one of the ancient vole Microtus beringianus *are found in great abundance along the Old Crow River. Research by palaeontologists John Storer and Elizabeth Hall helps explain rodent evolution during the ice age.*



Whitestone mammoth

Extinct ice age mammals are important to science and to Vuntut Gwitchin culture. In 1967, Old Crow resident Joe Kaye told palaeontologist Richard Harington a fascinating tale of a monster near the Upper Porcupine River. According to the story, the creature broke out of a lake bed, trudged up the river and died on the bank of the Whitestone River.

Complete lower jaw of the Whitestone Mammoth. Photo: Richard Harington

Legend became reality that summer when Harington and Peter Lord discovered the partial remains of an adult female Woolly mammoth near Whitestone Village. A radiocarbon date indicated that the mammoth died about 30,000 years ago. It was the most complete mammoth fossil skeleton ever found near Old Crow.

The Whitestone mammoth skeleton was used as model for a lifelike sculpture, which can be seen in downtown Ottawa; a copy is installed at Yukon Beringia Interpretive Centre in Whitehorse *(see photo, left).*

Right: Peter Lord beside the partial skeleton of the adult female Woolly mammoth laid out on the bank of the Whitestone River on August 5, 1967. Photo: Richard Harington

The mammoth family tree

Most fossils of ancient members of the elephant family found in Yukon belong to the relatively recent Woolly mammoth *(Mammuthus primigenius)*. Woolly mammoths arose around 300,000 years ago and went on to populate Eurasia after migrating west across the Bering Land Bridge. They were a mainstay of the ice age in Beringia and survived to as recently as 4,000 years ago on islands in arctic Siberia.

> "Mammoth — used to be, he lived in the ground. If he's going to die, he pushes his way to the water, to the river — like a D-9 Cat!"
>
> Charlie Peter Charlie Sr., 1996

However, these were not the only mammoths that lived near Old Crow. In 1981, Richard Morlan of Yukon Refugium Project found two complete lower molars in a bluff 275 km from the mouth of the Old Crow River, upstream from Surprise Creek. Four years later, two complete upper molars of similar character were found at the base of the same bluff, suggesting that all four belonged to the same animal.

The teeth are believed to be from the Woolly mammoth's ancestral relative, the Steppe mammoth *(Mammuthus trogontherii)*, which lived between 800,000 and 300,000 years ago.

Charlie Peter Charlie Sr., ca. 1970.
Photo: YA, Chief Zzeh Gittlit School collection #93/72

Above: A pick next to mammoth teeth, Old Crow River, July 2, 1973.
YA, Tim Schowalter fonds, 2007/81 #147
Background: Illustration of mammoth skull from Oliver Perry Hay: *Mammals of the Pleistocene. Annual Report of the Iowa Geological Survey, 1914*

The mammoth molars found in 1981 are different than those (which are more commonly found) from late Pleistocene mammoths. The width and shape of the tooth enamel indicate that the mammoth was at a much more primitive evolutionary stage than the typical Woolly mammoths of the late ice age.

Other isolated partial molars — from an even more ancient mammoth, possibly more than a million years old — have also been recovered in the Old Crow basin. This was the Southern mammoth *(Mammuthus meridionalis)*. These finds indicate that mammoths lived and evolved in the Old Crow region for most of the ice age.

DNA extracted from fossil bones and teeth reveal that the Woolly mammoth evolved from earlier ancestors in Alaska and Yukon. Analysis of DNA from the 1981 molars is underway by Hendrik Poinar of McMaster University and will certainly reveal a new chapter in mammoth history.

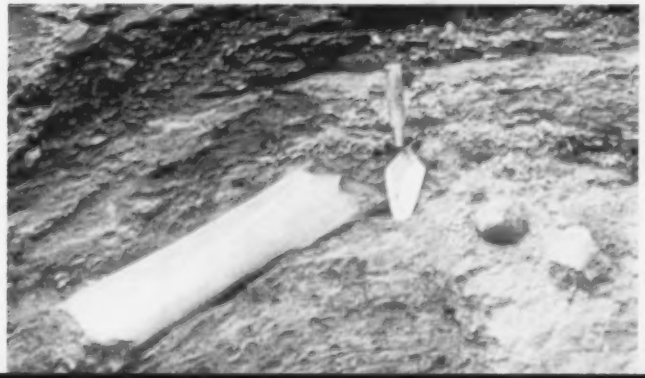
Right, top: Richard Harington has identified molars of the Southern mammoth (Mammuthus meridionalis) *from Old Crow.*

Right, centre: Palaeontologist Andrei Sher identified the molars collected by Richard Morlan as Steppe mammoth (Mammuthus trogontherii).

Photo: Andrei Sher

Right, bottom: Numerous vertical enamel plates form the chewing surface of a Woolly mammoth (Mammuthus primigenius) *tooth.*

Mammoth femur and trowel, 1978. Photo: Richard E. Morlan Fonds, CMC



Giant ground sloth

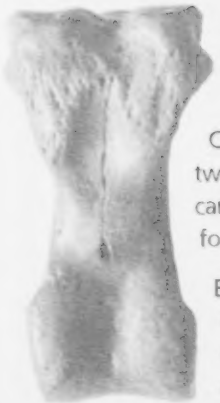
Sloths are now found only in the rainforests of Central and South America. Discovery of sloth fossils north of the Arctic Circle reveals how different life was during the ice age.

Sloths originated in South America and migrated north across the Isthmus of Panama around six million years ago. Study of sloth fossils recovered in the Old Crow basin by palaeontologists Greg McDonald and Richard Harington confirmed that they are from the Giant ground sloth *(Megalonyx jeffersonii* — named for U.S. president Thomas Jefferson).

This unusual sloth evolved in central North America and eventually found its way to northern Canada during the last interglacial. It was the most geographically widespread member of the sloth family on the continent. These herbivores were as big as bears and favoured leaves from trees and shrubs. Their sharp claws provided protection from fierce and faster ice age carnivores.

The Old Crow region is the only area of Yukon where Giant ground sloth bones have been found.

Above: Giant ground sloth exhibit at the Yukon Beringia Interpretive Centre in Whitehorse.
Illustration: George (Rinaldino) Teichmann



Arctic camels

It may be surprising to hear that camels used to live near Old Crow. Fossil bones from two distinct species in the camel family have been found in the region.

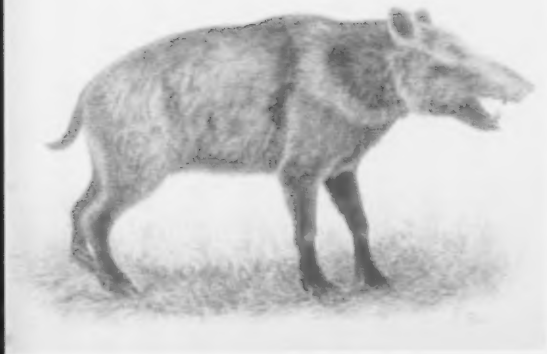
Bones of the Yukon Giant camel belong to a species of "true" camel called *Paracamelus*. Research published in 2013 by Natalia Rybczynski from the Canadian Museum of Nature shows that 3.5 million years ago, during the Pliocene warm period, these giant creatures lived as far north as Ellesmere Island.

Right: Illustration of the High Arctic camel on Ellesmere Island during the Pliocene warm period 3.5 million years ago.
Illustration: Julius Csotonyi, CMN

Yukon Giant camel fossils from Old Crow date to the early ice age and indicate that true camels had a long history in the Arctic. They ranged across Beringia into Asia and gave rise to the camels that later became domesticated.

Fossils of another ancient camel found in Old Crow are from the smaller Western camel *(Camelops hesternus)*. They migrated north to Old Crow, probably around 125,000 years ago during the warmer interglacial time. They were closely related to present-day alpacas and llamas on a separate evolutionary branch from the Yukon Giant camel. *Camelops hesternus* never crossed the Bering Land Bridge into Asia, but was common in western North America until near the end of the ice age.

Left: Fossilized toe bone of the Yukon giant camel. Photo: Richard Harington



Ice age pigs

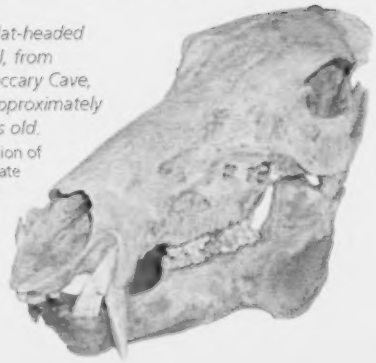
Few people think of pigs when they think about ice age life in Yukon. However, in 1977 the surprising discovery of bone from an ancient extinct pig along the Old Crow River provided evidence that they lived in the Arctic during the ice age.

Illustration: George (Rinaldino) Teichmann

Analysis of this rare fossil by Brenda Beebe of the Northern Yukon Research Programme revealed that it belonged to the Flat-headed peccary *(Platygonus compressus)*. The species had razor-sharp lower canine teeth for fighting and cheek teeth for chewing coarse vegetation. Peccaries were about the same size as a European wild boar.

This extinct member of the pig family is common in ice age sites in the mid-continental United States. The Old Crow fossil is only the second specimen of this species ever found in Canada — and is 3,000 km north of any previous discoveries!

Above: The peccary bone collected near Old Crow in 1977.



Right: This flat-headed peccary skull, from Megenity Peccary Cave, Indiana, is approximately 25,000 years old.

Photo: Collection of the Indiana State Museum and Historic Sites

Yukon's big and little horses

Horses are among the most common species found as fossils along the Old Crow River. Recent analysis of horse bones has determined that at least two, and perhaps three, different types of species of horses lived here during the ice age.

It is not well understood how these horses were related to one another. They are distinguished from one another largely based on size. The largest, *Equus verae*, is comparable to fossil horses found in Siberia that are about one million years old. They are the size of present-day domestic horses.

The most common species in Beringia was the small-bodied Yukon horse – *Equus lambei*, named for palaeontologist H.M. Lambe of the Geological Survey of Canada. These are the typical horses found during the later stages of the ice age. This small horse was only 1.2 metres tall at the shoulders.

Analysis of the DNA preserved in their bones is underway and should reveal further insights into the family tree of Yukon horse.

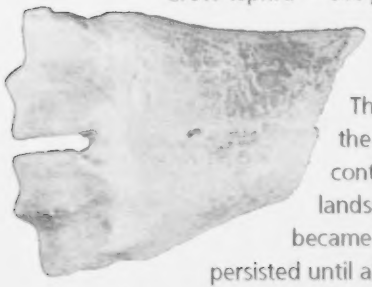
Above: Type specimen, Equus lambei, *found circa 1917.* Photo: Patricia Halladay, image copyrighted by the Department of Paleobiology, Smithsonian Institution, all rights reserved

Below: The feet, toes and hoofs of Equus verae *(left) and* Equus lambei *(right) suggest that horses got progressively smaller through the ice age in Yukon, possibly as a result of increased competition for food.*

The Canadian Museum of Nature in Ottawa houses tens of thousands of fossils collected by palaeontologists and Vuntut Gwitchin near Old Crow. Fossils such as these horse hooves are organized according to location, species and fossil type.

The most ancient bison in North America

Every once in a while, a scientist makes a discovery that changes our understanding of the past. In the summer of 2006, while examining geological deposits at *Chijii Vihk'àa* (Big Bluff) on the Porcupine River, geologist Alberto Reyes found a fragment of a Steppe bison foot bone. The bone lay next to volcanic ash (the Old Crow tephra — *see page 20*) that was known to be 125,000 years old. This proved to be the most ancient bison fossil ever found in North America!



The discovery establishes when bison first crossed the Bering Land Bridge from Asia and colonized the continent. This migration had dramatic effects on the landscape of North America. Soon after their arrival, bison became the most prominent large mammal species; they persisted until after the end of the ice age. These bison evolved into the present-day wood bison and plains bison of the recent past.

From the 16th century, when the earliest European explorers ventured across North America, until the mid-19th century, people saw bison in immense wild herds. The last bison from Yukon disappeared only about 400 years ago. In the last few decades they have been reintroduced here.

Above, left: Bones of ancient bison are among the most abundant ice age fossils found in Yukon. Discoveries such as this 125,000-year-old bison foot bone fragment demonstrate the importance of collaboration between palaeontologists and geologists to reveal the age of fossils.

Richard Harington with a skull fragment from a Steppe bison collected near Old Crow in 1971.
Photo: Richard Harington

Beavers the size of bears

The Giant beaver *(Castoroides ohioensis)* was the largest rodent in North America during the ice age. These ancient beavers were about 2.5 metres long and weighed up to 100 kg. Their incisor teeth were the length of a five-dollar bill.

Above: Natalia Rybczynski and Keith Rispin excavate beaver-cut sticks along Old Crow River, 2005.

"We also dug out a cottonwood stump which evidently had been cut down by beavers; and from the width of the tooth marks, it could have been cut down by a Giant beaver."

Otto Geist, 1956

Giant beavers preferred wooded habitats with ponds, so it is likely that they lived in Yukon only during the last interglacial period, when the climate was similar to what it is now. Chemical analyses of fossil teeth from Wisconsin indicate that Giant beavers ate aquatic pond plants, not trees or wood. They were common south of the Great Lakes and in Eastern North America, where they survived until the end of the ice age.

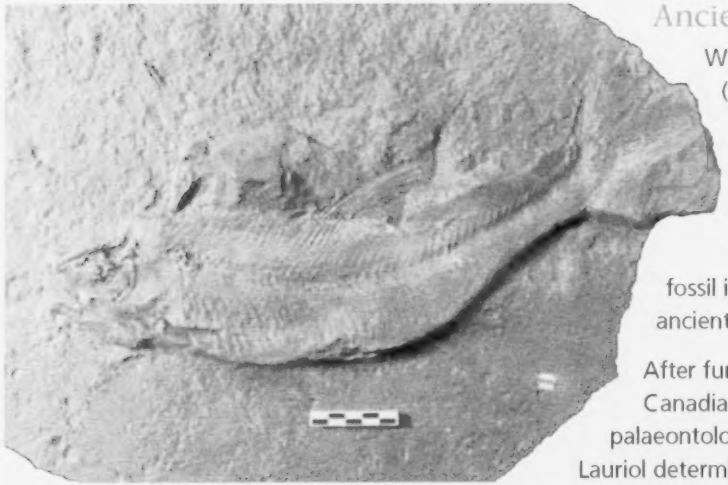
Their bones and distinctive incisor teeth are often found along the Old Crow River. Fossils of Giant beaver in the Old Crow area were first reported in 1926 by O.J. Murie of the United States Biological Survey. Almost eighty years later, in the summer of 2005, palaeontologists Paul Matheus and Natalia Rybczynski, along with Keith Rispin of the Vuntut Gwitchin, made a startling discovery. They found an ice age beaver dam in the bank along the Old Crow River that contained a mammoth bone used in place of a log. It has not yet been determined whether this dam was built by the Giant beaver or its modern-day relative, *Castor canadensis*.

The skull of a Giant beaver (left) and its modern-day cousin (right). Photo: Claire Eamer

"*Ch'ataiiyùukaih* went to below Fort Yukon. Yukon River is a big river. There was a Giant beaver there and he had a dam across Yukon River. He was as big as a black bear, that beaver. They say that *Ch'ataiiyùukaih* fixed the beaver, made him like beaver today."

Charlie Peter Charlie Sr.
Vuntut Gwitchin elder, Old Crow
From *Ch'ataiiyùukaih* – Traveller,
Adapted from Charlie Peter Charlie Sr.
interview on Rampart House,
in Rampart House (1993)

Illustration of Giant Beaver *(Castoroides ohioensis)*: George (Rinaldino) Teichmann



Ancient fish

While investigating rocks and sediments at *Chijii Vihk'àa* (Big Bluff) on the Porcupine River in 1997, University of Ottawa geologist Bernard Lauriol encountered a peculiar large oval rock. When he hit the rock with his rock hammer it split in half, revealing an immaculately preserved fossil impression of an ancient fish.

After further study with Canadian Museum of Nature palaeontologist Steve Cumbaa, Lauriol determined that the fossil was between 2.6 million and 780,000 years old. That made it the oldest fossil ancestor of living whitefish. Although on first glance the fossil looks like a typical whitefish, the measurements and characteristics of its scales, fins and body proportions indicate that it is a previously unknown species.

Other fish fossils from species common today, such as pike and grayling, have also been recovered from the bluffs exposed along the Old Crow River.

Above: Fossil whitefish from Chijii Vihk'àa *(Big Bluff), Porcupine River.*

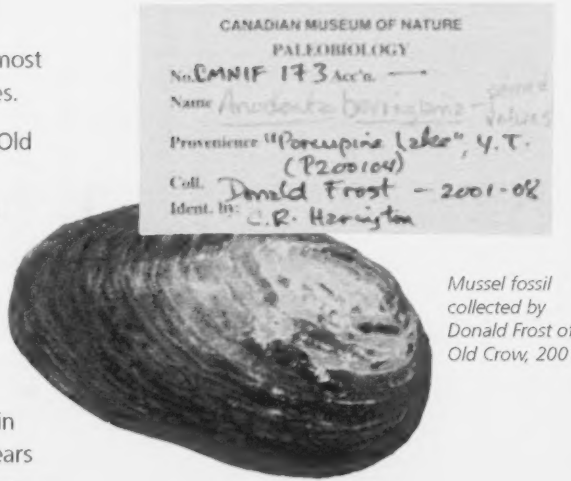
Below: Grayling scale fossils.

The mussels of Beringia

Fossil shells of a curious freshwater mussel have been found along the Old Crow and Porcupine rivers. This shellfish is known as Yukon floater *(Anodonta beringiana)*.

This mussel inhabited the waterways near Old Crow for a brief period between 11,500 and 9,000 years ago. Its fossil shells are distributed much more widely than those of its modern-day equivalents; these are the northernmost and easternmost sites for this species.

This mussel does not now live near Old Crow. It is found only in eastern Russia and in the Pacific, Bering Sea and Arctic drainages of Alaska. Its larvae are carried up rivers by attaching themselves to the bodies of Chinook salmon and other migrating fish.



Mussel fossil collected by Donald Frost of Old Crow, 2001.

The presence of these fossils in the Old Crow River 11,500 years ago marks when the Porcupine River became connected to the Pacific Ocean via Yukon River, as it is now. Before then, the region was covered by Glacial Lake Old Crow *(page 18)* and the rivers drained east into the Arctic drainage.

Sometime after 9,000 years ago as temperatures cooled Yukon Floater mussels in the Old Crow River died off. However, shells collected on the upper Porcupine River by Old Crow resident Donald Frost indicate that they made a brief reappearance 1,200 years ago.

Left: The advance of glaciers to the Richardson Mountains (in distance) during the ice age re-routed the Peel River through the Eagle River valley (foreground). Photo: Duane Froese

Bluefish Caves

The search for evidence of ice age people has long brought scientists to the Old Crow region. For centuries, people have wanted to know when the first people migrated from Asia to North America. The answer may lie in three small caves on a high ridgetop overlooking the Bluefish River, southwest of Old Crow. The caves have provided some of the most informative yet enigmatic evidence of the first people to live in Canada.

Right: The Bluefish Caves. Photo: Ruth Gotthardt

The three caves were discovered from the air in 1975 by archaeologists Jacques Cinq-Mars and William Irving from the Northern Yukon Research Programme *(see page 14)*. Digs led by Cinq-Mars found that the silt-filled caves contained the buried bones of mammoths, horses, caribou, saiga antelope, bear, lion and many other mammals, as well as birds and fish.

Left, l–r: Old Crow residents Florence Netro, Mary Jane Moses and Brandon Kyikavichik with archaeologist Ray Le Blanc (foreground) and pilot Mike Park (second from right) in Bluefish Cave. Photo: VGG

Marks on some of the large mammal bones suggested that people were butchering these animals at the caves during the ice age. The windblown silt in the caves is evidence of the cold dry climate on these ridge tops at that time.

Ice age hunters

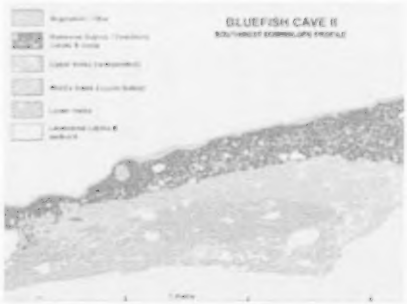
Stone tools left behind by ancient hunters were also found in two of the Bluefish Caves. The tools are very similar to those found at other sites in Alaska and Yukon that date to the end of the ice age.

Above: Archaeologists Ruth Gotthardt and Jacques Cinq-Mars in front of Bluefish Cave III, 1997.

Some archaeologists assert that the Bluefish Caves contain evidence for ice age hunters as far back as 25,000 years ago, although this is open to much debate. Most archaeologists maintain that the caves were occupied by people only around 14,000 years ago, which is more consistent with evidence in Alaska.

The combined record of mammals, fish, birds, plants and humans — together at one location — make the Bluefish Caves a cornerstone site for ice age research. It paints a vivid picture of a rich array of Arctic life during one of the coldest times of the ice age.

Right: Tom Andrews and Ellen Badone, with the Northern Yukon Research Programme, excavating the bone bed outside of Bluefish Cave I, August 1979. Photo: Ruth Gotthardt



Above: This shows the layers that archaeologists and palaeontologists had to dig through at Bluefish Cave. Illustration: Jacques Cinq-Mars

Ancient caves

Bluefish Caves were not the only caves found by the Northern Research Programme. Their work documented hundreds of caves that wind through the bedrock ridges and mountains south of Old Crow. Few of them have been thoroughly studied by scientists and their hidden treasures are yet to be discovered.

These caves were formed before the ice age, when the warm climate allowed water to percolate through the rock and form tunnels. This water froze during the ice age and many of the caves contain spectacular ice features.

Bear Cave south of Old Crow has revealed a fascinating story of ancient people after the ice age. Scientists Bernard Lauriol and Ian Clark discovered large logs of spruce and poplar wood on the cave floor. People chopped these trees down and dragged them up the mountainside into the cave more than 8,000 years ago.

Traditional stories from Old Crow say that the caves were used when people hunted hibernating grizzly bears during lean winters. They also say that the caves have not been used at all by people in the 20th century.

Left: Lance Nagwan at Big Nest Mountain.
Photo: VGG

Long-ago stories

Stories passed on for generations by Vuntut Gwitchin elders demonstrate the connection between them and their land. One important story focuses on the mythical hero *Ch'atsiiyùukaih* (see page 32) — also known as the traveller — who transformed the ancient large animals into their current, smaller form so they would no longer be a threat to people. These stories may have arisen from encountering fossil bones of huge mammoths and Giant beavers along the rivers.

Above, l–r: John Joseph Kaye and Abraham Peter, with boat loaded with moose meat, circa 1975.
Richard E. Morlan Fonds, CMC IMG2013-0043-0006

Above: Interpreter Dorothy Frost with visitors at the John Tizya Centre in Old Crow.
Parks Canada/Kate Alexander

"We cannot know ourselves and the history of how we came to be without researching, and being involved as much as possible, with these types of projects."

Brandon Kyikavichik, VGFN

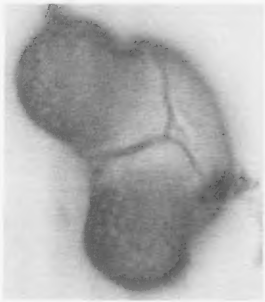
Other stories of large floods parallel the changes in lakes and rivers that occurred in the Old Crow region at the end of the ice age. These stories have been important to the scientists who are also trying to understand the dramatic changes that animals and the land went through in the ancient past.

Many of the fossils found since 1995 are part of the collections at the Arctic Research Facility that was built in 2010 in Old Crow. Visiting scientists work in close collaboration with the VGG to develop and carry out field research projects, provide educational opportunities and learn from the people of Old Crow.

The end of the ice age

The ice age world was gone by 10,000 years ago and most of the large iconic mammals had become extinct. What could have caused such a devastating loss of life in a short time? Bones from the Old Crow region are helping resolve this mystery.

Some people argue that the development of new technologies and the spread of human populations near the end of the ice age caused these large mammals to die off. Ancient people may have over-hunted large mammals, which were their favourite food source. Wherever ancient people traversed the globe, extinctions seem to follow in their footsteps.



On the other hand, climate change at the end of the ice age may have made the environment inhospitable to large mammals. As the climate warmed, the rich grassy landscapes of the north were replaced by shrubs, then trees.

Not only did it get warmer, it got wetter, and bogs and lakes formed after the ice age. Animals such as horses and mammoths need grass to eat; once the mammoth-steppe was gone, these mammals would starve. The environmental changes at the end of the ice age may have been too rapid for mammals to adapt to new food sources or migrate to more favourable areas.

But as these ice age mammals disappeared, a new group of large mammals appeared, including moose *(right)* and elk. These new mammals were well adapted to life in the Old Crow region after the ice age.

Above: A microscopic Black spruce (Picea Mariana) *pollen grain.*

Left: The study of fossil plants and pollen by James Ritchie, Les Cwynar and Lynn Ovenden of the NYRP document the changes from rich grasslands (similar to this one) to spruce forest near the end of the ice age. Photo: Svetlana Kuzmina

Brandon Kyikavichik at Bluefish Caves. Photo: VGG

Acknowledgements

This work is dedicated to the many Vuntut Gwitchin who have welcomed scientists to their traditional territory and provided gracious and generous assistance to researchers for more than a century.

The study of the Ice Age Old Crow is truly a team effort — Team Beringia. We thank all those who have put in countless hours conducting analyses, writing papers, driving boats, hauling packs, setting up camps and sharing their expertise and passion.

Funding for research in the Old Crow region was provided by the Yukon Department of Tourism & Culture and the Heritage Department of Vuntut Gwitchin Government, and by research grants from the Natural Sciences and Engineering Research Council, International Polar Year, University of Alberta, Northern Scientific Training Program of DIAND, Alberta Ingenuity, Geological Survey of Canada, Yukon Geological Survey, Canadian Museum of Nature, Canadian Museum of Civilization, United States National Science Foundation, National Geographic Society and Leverhulme Trust.

Many thanks are extended to the staff at the Yukon Beringia Interpretive Centre, John Tizya Centre, Canadian Museum of Nature, and Canadian Museum of Civilization, which work hard to bring to life the stories of ice age Old Crow.

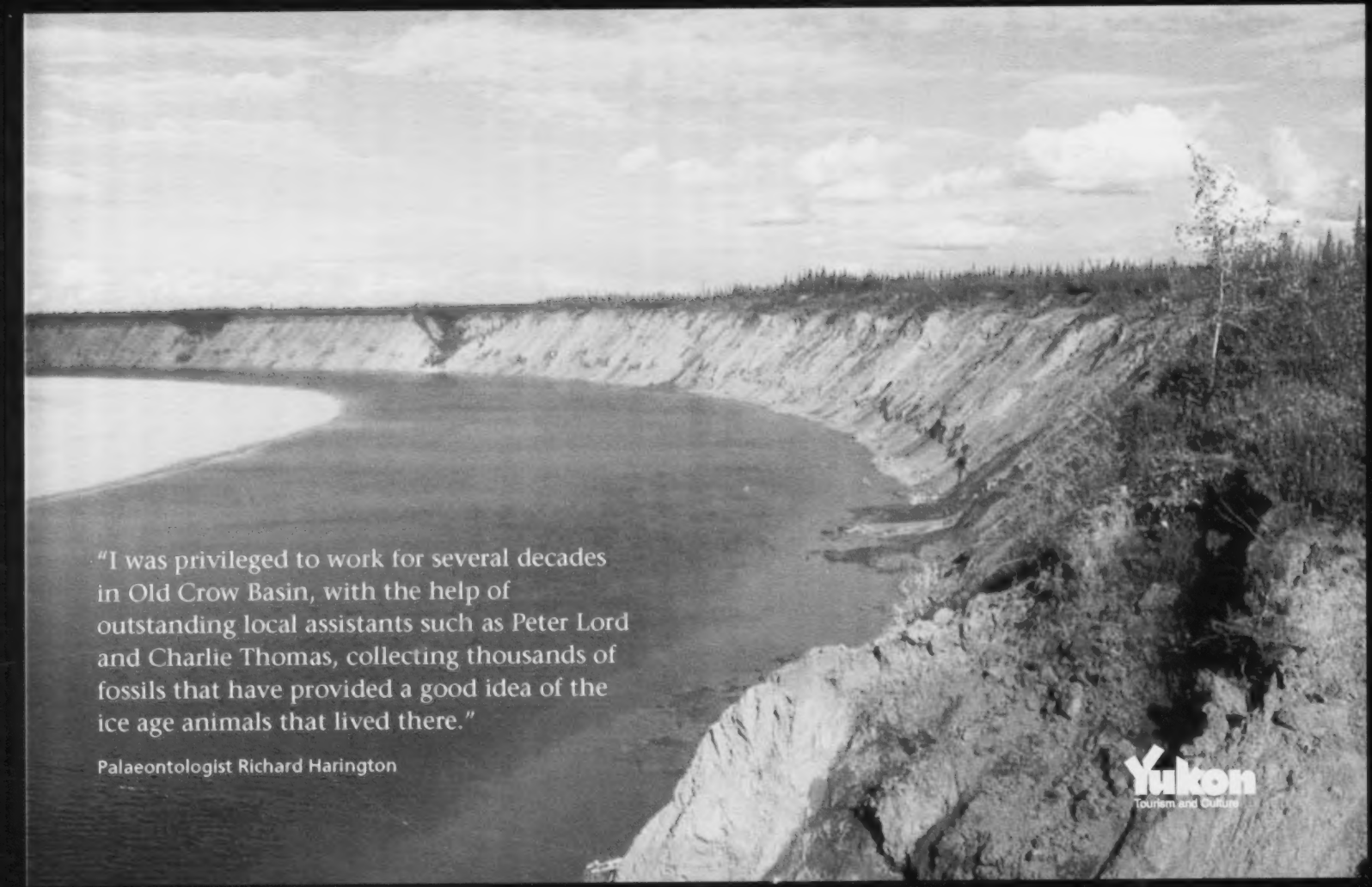
We also thank the many scientists, colleagues and assistants, past and present, who have helped build the scientific record of ice age Old Crow: Copley Amory Jr., Tom Andrews, Lee Arnold, Ellen Badone, Darlene Balkwill, Brenda Beebe, Peter Benjamin, Wes Blake Jr., Miguel Bombin, Robson Bonnichsen, Peter Bobrowsky, Fiona Brock, Harold Bryant, Ariane Burke, Chris Burn, Fabrice Calmels, Alfred Charlie, Charlie Peter Charlie Sr., Stephen Charlie, Rufus Churcher, Jacques Cinq-Mars, Donald Clark, Ian Clark, E.J. Crossman, Les Cwynar, Steve Cumbaa, Margaret Currie, Jane and Joan Dale, James Dixon, Alejandra Duk-Rodkin, Scott Elias, Gerry Fitzgerald, Claire Fleming, Max Friesen, Dennis Frost Sr., Donald Frost, Harold (Hal) Frost Jr., Stephen Frost Sr., Otto Geist, Ruth Gotthardt, Elizabeth Hall, Tom Hamilton, Greg Hare, Dick Harington, Owen Hughes, William Irving, Jan Janssens, Britta Jensen, A.V. Jopling, Vernon Kaye, Kristen Kennedy, John Kolar, Tyler Kuhn, Josh Kurek, Svetlana Kuzmina, Brandon Kyikavichik, Bernard Lauriol, Raymond Le Blanc, S. Lichti-Fedorovich, Charlie Linklater, David Lord, Peter Lord, A.G. Maddren, Ross MacPhee, Mathew Mahony, Paul Matheus, John Matthews Jr., D.E. McAllister, George McCourt, Greg McDonald, Athena McKown, Jessica Metcalfe, Dick Mol, Heather Morlan, Richard Morlan, O.J. Murie, Shweta Nalawade-Chavan, Lance Nagwan, Erle Nelson, Garry Njootli, Lynn Ovenden, David Parama, Nick Pearce, Hendrik Poinar, Shari Preece, Joel Pumple, Vern Rampton, Alberto Reyes, Keith Rispin, James Ritchie, Bert Roberts, Nat Rutter, Natalia Rybczynski, Paul Sanborn, Howard Savage, Anna Sawicki, Charles Schweger, Beth Shapiro, Andrei Sher, Scott Smith, Ruth Stockey, John Southon, Mathias Stiller, John Storer, Alice Telka, Kenny Tetlichi, Charlie Thomas, Robert Thorson, Robert Vance, Kerry Walde, Pamela Waters, John Westgate, Megan Williams, Brian Yorga and Philip Youngman. Our apologies to anyone we have overlooked.

About the authors

Grant Zazula is the Yukon Palaeontologist with the Yukon government's Department of Tourism and Culture. He has been conducting research on the ice age Yukon since his first trip north to Old Crow in the summer of 1999.

Duane Froese is an Associate Professor and Canada Research Chair in the Department of Earth and Atmospheric Sciences at the University of Alberta. Since 1995 he has led teams of researchers studying the ice age history of Yukon.

Old Crow resident Danny Kassi on a sandbank near Old Crow with a mammoth tusk, 1979.
YA, Danny Kassi collection, 2002/66 #1


"I was privileged to work for several decades in Old Crow Basin, with the help of outstanding local assistants such as Peter Lord and Charlie Thomas, collecting thousands of fossils that have provided a good idea of the ice age animals that lived there."
Palaeontologist Richard Harington
Yukon
Tourism and Culture